

Original Research

The influence of nutrition education intervention combined with FIFA11+ program on physical fitness attributes, physical activity behaviors, eating habits and nutritional knowledge in young basketball players

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Abstract: The aim of this study was to analyze the effects of a nutritional education program combined with the FIFA 11+ program on physical fitness attributes, physical activity levels, food and nutritional habits and nutritional knowledge in young basketball players. Twenty-three under 14 elite basketball players (13 males and 10 females) belonging to a professional basketball academy participated in the study. Physical fitness attributes (countermovement jump [CMJ], drop jump [DJ], linear sprint, Lane Agility Drill, 505 change-of-direction, and repeated-change-of-direction [RCOD]), physical activity levels (Physical Activity Questionnaire for Adolescents, PAQ-A), eating and nutritional habits (Turconi questionnaire), and nutritional knowledge (modified version of the Turconi questionnaire) were assessed before and after the five months intervention period. Participants were involved in five nutrition education sessions and in a weekly session of the FIFA 11+ program. Pre-to-post differences revealed improvements in physical fitness attributes (i.e., CMJ, Lane Drill Test and RCOD time test [$p < 0.05$; effect size (ES) = 0.52 to -1.68]) and physical activity behaviors (PAQtotal and PAQ Lunch [$p < 0.001$; ES = 0.68-0.89]), as well as a maintenance of eating and nutritional habits and nutrition knowledge. In practical terms, the usual on-court and the implementation of nutrition education interventions combined with the FIFA 11+ improve physical fitness attributes and physical activity behaviors while favor the maintenance of eating and nutritional habits and nutrition knowledge in U14 elite basketball players.

Keywords: team sports; eating; diet; performance; health; adolescent.



1. Introduction

Basketball is a worldwide practiced team sport (Hulteen *et al.*, 2017) which is highly demanding regarding technical, tactical, psychological and conditional variables (Montgomery *et al.*, 2010) in all practice levels. In a conditional approach, a great amount of high intensity actions, such as jumps, sprints and change of directions, are required during a basketball match (Ziv & Lidor, 2009), which are determinant to achieve a great on-court competitive performance (ben Abdelkrim *et al.*, 2007). In this sense, several factors such as a high rate of wellness state (i.e., sleep, stress, fatigue, muscle soreness...) as well as adequate eating habits are crucial to cope match demands in basketball players (Sánchez-Díaz *et al.*, 2021). This could be a key factor for young players, since an inadequate physical condition together with nutritional deficits could affect both their sports career and their quality of life in adulthood (Mujika *et al.*, 2018). For this reason, the application of strategies to optimize the physical condition and consumption habits of basketball players seems essential, favoring a holistic preparation of the athletes.

From a nutrition and dietetic point of view, nutrition education interventions are considered as a key factor for the team sport athletes' preparation (Sánchez-Díaz *et al.*, 2020). These strategies could be defined as specific programs designed to assist targeted populations in acquiring relevant knowledge or adopting improved eating behaviors maintaining or improving health and enhancing athletic performance (Murimi *et al.*, 2017). Among these strategies, there are some modalities, including personal interviews (Valliant *et al.*, 2012), group activities (Patton-Lopez *et al.*, 2018), comics (Zeng *et al.*, 2020), interactive workshops (Patton-Lopez *et al.*, 2018), or technological platforms (Abood *et al.*, 2004). However, the effectiveness of each modality of nutrition education interventions needs to be analyzed to identify the most appropriate approach to each context. Specifically, Rossi *et al.* (2017)

observed improvements in baseball players' eating habits and decrements in their body fat percentage using an educational intervention based on in face-to-face individual sessions. On the other hand, Zeng *et al.* (2020) applied a nutrition education intervention through comic books, increasing the nutrition knowledge in volleyball players. Finally, Shoemaker *et al.* (2019) achieved significant improvements in the physical performance (i.e., vertical jump, broad jump and push-up force) of team sport athletes after the application of an online sports nutrition curriculum. Despite this, to date, only one study (Kavouras *et al.*, 2012) has been carried out with basketball players, although combined with volleyball players, so future studies on this topic are necessary, since this could provide value information to nutritionists to optimize the training process in this population.

Previous studies have shown the efficacy of different complementary programs to daily training (e.g., high-intensity interval training, repeated sprint ability or power training programs) on the physical condition of young basketball players (Gonzalo-Skok *et al.*, 2016; Padulo *et al.*, 2015; Zeng *et al.*, 2021). However, when designing or selecting such programs, the specific characteristics of team sports must be considered (e.g., congested schedule or high number of official matches) (Wing, 2018). In this sense, the FIFA 11+ program has shown great applicability in specific contexts of team sports athletes (al Attar & Alshehri, 2019; Lopes *et al.*, 2020). Specifically, FIFA 11+ is a multi-exercises warm-up developed Medical Assessment and Research Center (F-MARC) in team sports to make injury-prevention and performance programs more accessible (Dvorak, 2005). Specifically, previous research has shown positive effects after the application of this program in team sport populations in both performance and injury prevention (Nawed *et al.*, 2018; Nuhu *et al.*, 2021), although references to basketball players are scarce. Regarding this, only one study (Longo *et al.*, 2012) has been carried out

with young basketball players, showing that the FIFA 11+ is effective in reducing the rates of injuries in this group. Given that the typology of this program has shown promising results and it allows its application as a warm-up prior to any training session without interfering with the subsequent content, it seems appropriate to analyze its effects on young basketball players.

Since the application of nutritional education strategies and the FIFA 11+ program isolated have shown benefits in different populations of team sports athletes but their application to basketball is scarce, it would be pertinent to apply a combined program consisting of both strategies in young basketball players. Therefore, the aim of this study was to analyze the effects of a nutritional education program combined with the FIFA 11+ program on physical fitness attributes, physical activity levels, food and nutritional habits and nutritional knowledge in young basketball players. Based on previous studies (Nawed et al., 2018; Rossi et al., 2017), we hypothesize that after the application of this combined program, basketball players will improve their physical performance, eating habits and nutritional knowledge.

2. Materials and Methods

Subjects — A convenience sample of twenty-three under 14 (U14) elite basketball players (13 males and 10 females, age: 13.1 ± 0.4 years, height: 164.6 ± 5.7 cm, body mass: 54.4 ± 9.9 kg, percentage of body fat: $19.4 \pm 6.5\%$, percentage of muscle mass: $35.7 \pm 4.7\%$, training experience: 5.5 ± 2.6 years) belonging to the same elite basketball academy (i.e., Spanish Asociación de Clubes de Baloncesto [ACB] League) were selected to participate in this study. All players were members of teams competing at the highest competitive level in Spain for the U14 age category and their on-court team training consisted on games-based and conditioning drills three times per week with each session typically lasting 75-90 min, as well as participating in one official match per week. Players were included in the study if they completed all

fitness assessments, questionnaires, assisted to five nutrition education sessions and were free of injuries the two months prior to the experimental period. Additionally, players who missed more than 20% of the sessions (i.e., on-court and additional sessions) over the five months intervention period were excluded from the final analysis. All participants and their legal guardians were informed about the procedures, potential risks, and benefits of the study before signing a written informed consent. The study was performed in accordance with the Declaration of Helsinki (2013) and approved by the Ethics Committee of the Universidad Isabel I (FUI1-007).

Design — A longitudinal study design was applied to analyze the effects of a nutritional education program combined with the FIFA 11+ program on eating habits, nutritional knowledge and physical fitness attributes in young basketball players. Before and after of the intervention period, players completed a basketball-specific fitness test battery including jumping tests [countermovement jump (CMJ) and drop jump (DJ)], linear sprint tests, Lane Agility Drill test, 505 change-of-direction (COD) test, and repeated change-of-direction (RCOD) sprint test. Prior to testing, all players performed a standardized warm-up consisting of running at a moderate intensity for five min, followed by five min of jumps performed at progressively increasing intensities, five min of dynamic stretching exercises, and three min of 20 m running bouts performed at increasing intensities. These tests were performed in a single session on an indoor basketball court (15–18 °C, 60–70% relative humidity), with five min of passive, standing recovery applied between tests. All tests were carried out three days following official competition in the afternoon between 16:00 h and 19:00 h. Also, before physical testing, players completed questionnaires regarding physical activity behaviors, nutritional habits, and nutritional knowledge on their own and not in the presence of peers. All of these questionnaires were previously validated. During the five months intervention period, players

completed five nutrition education sessions and performed one weekly session of the FIFA11+ program. Players were familiarized with the study protocol during training sessions across the month before the start of the study, including all physical fitness tests and questionnaires. Likewise, players were advised not to perform any physical exercise in the two days prior to testing and were given advice to ensure adequate hydration and nutritional status (avoiding the caffeine consumption or similar) upon arrival for testing. The experimental intervention took place during the in-season phase (October to February), in the afternoon (between 16:00 h and 19:00 h), of the 2020–2021 competitive season.

Physical fitness tests -

Jumping tests — Players performed two trials each of the CMJ and DJ to assess the jump height (cm) through a photocell system (Optojump, Microgate™, Bolzano, Italy). Each jump trial was separated by 45 s of passive, standing recovery, and the highest jump was used for subsequent analysis in each test. During CMJ trials, players were instructed to perform a downward movement followed by a complete, rapid extension of the lower-limbs, maintaining their hands on their hips while jumping as high as possible (Heishman et al., 2020). For DJ trials, players were instructed to step from a wooden box (30 cm height) and immediately following ground contact, jump for maximal height as quickly as possible (Marshall & Moran, 2013). In the current sample of players, the between-trial intraclass correlation coefficients (ICCs) for jump height attained during both tests was 0.97.

Linear sprint test — Players completed two trials of 20 m linear at maximal effort to assess linear speed, using four pairs of photoelectric cells (Polifemo, Microgate™, Bolzano, Italy) to record sprint split times sprints (i.e., at 5 m, 10 m, and 20 m). Each sprint trial was separated by 120 s of passive, standing rest. Players started each sprint 0.5 m before the first timing gate and upon their own volition. The fastest time (s) for each split (irrespective of the trial) was

used for further analysis. In the current sample of players, the between-trial ICCs were 0.70, 0.67, and 0.75 for 5, 10 and 20 m sprint times.

Change-of-direction (COD) speed tests

— The Lane Agility Drill test and the 505 COD test were used to assess COD time in players. For the first of them, basketball players followed the protocol previously used by (Raya-González et al., 2021), while in the second test, players completed the protocol described by (Castillo et al., 2021a). Two trials of each test with 90 s of passive were completed, and standing rest was applied between trials. A photocell timing gate (Polifemo, Microgate™, Bolzano, Italy) was used to determine the time employed to complete both tests, and the fastest trial was used for subsequent analysis in each test. The ICCs were 0.90 for the Lane Agility Drill test and 0.74 for the 505 COD test in the current sample of players.

Repeated change-of-direction (RCOD) sprint test

— A single trial of the RCOD sprint test was administered. This test consisted in the repetition of 5 × 30 m shuttle sprints (15 m + 15 m) interspersed with 30 s of passive, standing recovery between each sprint. A single pair of photoelectric cells (Polifemo, Microgate™, Bolzano, Italy) were used to determine the time to cover each repetition. Players started 0.5 m before the first timing gate and sprinted for 15 m, before touching a line on the floor with their preferred foot and returning to the starting position as fast as possible (Castillo et al., 2021a). The sum of the 5 shuttle sprint times (total performance time during the RCOD sprint test) was calculated and used for subsequent analysis.

Questionnaires - The questionnaires were conducted following a typical week in which players maintained their normal daily routines involving attendance at school on five days, three on-court training sessions, and participation in an official match during the weekend.

Physical Activity Questionnaire for Adolescents (PAQ-A) — This questionnaire is composed by nine questions (5-point Likert scales) aiming to assess the physical activity behaviors of players outside of regular

basketball training and competition across the entire week (i.e., Monday to Sunday) prior to testing. The first six questions in the questionnaire are related with the physical activity carried out in the last seven days during leisure time, during physical education classes, during specific times on school days (i.e., lunch, afternoon, and night), and during the weekend, while the last two questions are focused on the level of physical activity carried out during the week and how often physical activity occurred on each day of the week. The average of the scores obtained in the first eight questions is used as the PAQ-A final, being the last question used to identify whether any circumstances that prevented usual physical activity occurred in the week analyzed. Transformation techniques were used to transform the raw data on a scale ranging from 0 to 100 (Müller et al., 2016). The PAQ-A was designed for and validated (ICC = 0.71 for total score) in males (n = 46) and females (n = 36) aged 13 to 18 years (Martínez-Gómez et al., 2009).

Dietary questionnaire. – A modified dietary questionnaire was applied to identify the nutritional habits and nutritional knowledge of players. This questionnaire was originally used by (Turconi et al., 2003), which was composed of 10 sections. However, we only used three sections (i.e., B, C, and H) following to (Sánchez-Díaz et al., 2021) in young basketball players. These sections were relevant for this study and thus used to assess player eating habits and nutritional knowledge. Transformation techniques were used to transform the raw data on a scale ranging from 0 to 100 (Müller et al., 2016).

Intervention -

Nutrition education interventions – During the experimental period, five nutrition education sessions were applied (once per month). These sessions were conducted in a relaxed atmosphere by a nutrition and dietetics specialist, who designed all the nutrition education

program. The sessions were performed face-to-face and online, combining theoretical information (i.e., slide show presentation and guided discussion) with several games. During these nutrition education sessions topics such as food groups (e.g., foods and nutrients), varied and balanced diet (e.g., recommended and usual portion), food typologies (e.g., fresh and processed) and nutritional labeling were discussed. The sessions had a mean duration of 60 min and were carried out prior to the basketball training session.

Physical activity intervention (FIFA 11+) – During the five months experimental period, a weekly session (i.e., 20 sessions) of FIFA11+ was performed by basketball players. Each FIFA11+ session lasted between 15 to 20 min and was conducted immediately after a general warm up and before the regular on-court basketball training sessions (60 min to 75 min). All FIFA11+ sessions were supervised by the strength and conditioning staff of the team, providing adequate feedback and cues for exercise and drill execution. During these sessions, players performed running, strength, plyometric and balance exercises, as proposed by (Dvorak, 2005). FIFA 11+ sessions were included within the basketball periodization as shown in Table 1 since this training program has improved the power performances (i.e., sprint and jumping) in basketball players (Nawed et al., 2018).

Statistical Analysis – Data are presented as mean \pm standard deviations (SD) for quantitative variables or frequencies and percentages for qualitative variables. Normal distribution of data was assessed by the Shapiro-Wilk test, and paired t-test or Wilcoxon rank sum test were used to examine differences in those quantitative variables regarding to physical fitness attributes, physical activity levels, eating habits and nutritional knowledge after the five months intervention period (Pre and Post).

Table 1. In-season weekly program for the U-14 basketball teams.

		<i>Day of the week</i>						
		Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
			<i>Duration: 70 min</i>		<i>Duration: 80 - 90 min</i>	<i>Duration: 70 min</i>		
Training program	<i>Rest</i>		Warm-up: 15 min Free throw shooting: 10 min Technical training: 20 min Small sided games: 25 min	<i>Rest</i>	Warm-up: 15 min FIFA 11+ session: 15 to 20 min Tactical training: 20 min Simulated game: 30 min	Warm-up: 15 min Speed training: 10 min Small sided games: 15 min Tactical training: 20 min Shooting exercises: 10 min	<i>Match</i>	<i>Rest</i>

Note: Once a month on Tuesday nutrition education sessions topics were carried out during 60 min each.

Also, McNemar test was applied to those dichotomous qualitative variables to examine the effect of the intervention program on the aforementioned variables. In addition, to analyze between-groups (i.e., male and females) differences after the intervention, an analysis of covariance (ANCOVA), assuming baseline values as covariates, was applied. Cohen's effect size (ES) was used for those quantitative variables which fulfilled the principle of normal distribution of data (Cohen, 1988), and eta square for those quantitative variables which did not fulfill the principle of normal distribution of data. The following scales was used to interpret magnitudes: <0.1, trivial; small, 0.11-0.30; intermediate, 0.31-0.50; and strong, >0.50 (Hopkins et al., 2009), and eta squared <0,25, 0,26-0,63 y >0,63, as small, intermediate and strong effects, respectively. Data analysis was carried out using the Statistical Package for Social Science (SPSS Statistics for Windows, version 25.0, IBM Corp., Armonk, N.Y., USA), with statistical significance set at $p < 0.05$.

3. Results

Changes in physical fitness attributes after 5-months period of nutrition education

intervention and FIFA11+ training are shown in Table 2. Elite U14 basketball players improved significantly bilateral (CMJ: $p < 0.001$, strong) and unilateral (CMJRight: $p = 0.008$, strong; CMJLeft: $p = 0.040$, strong) jumps, COD (Lane Agility Drill test: $p < 0.001$, strong) and RCOD sprint test times ($p < 0.001 - 0.006$, strong). In addition, individual changes after 5-months period of nutrition education intervention and FIFA11+ training are presented in Figure 1 (A: CMJ; B: CMJRight; C: CMJLeft), Figure 2 (Lane Drill Test) and Figure 3 (A: RCOD sprint 1-5 tests; B: RCOD sum time test).

Regarding to physical activity behaviours, PAQtotal and type of physical activity before and after lunch across the last 7 days (PAQ3 Lunch) was improved significantly after 5-months period of nutrition education intervention and FIFA11+ training in elite under 14 basketball players (Table 3).

No significant changes ($p > 0.05$) were detected after 5-months period of nutrition education intervention and FIFA11+ training (Supplementary Tables) in elite under 14 basketball players in food habits (section B) and nutritional (section C) habits, and nutrition knowledge (section H)

using the modified version of Turconi questionnaire (Sánchez-Díaz et al., 2021).

Additionally, no significant differences between gender groups after the intervention were observed ($p > 0.05$).

Table 2. Changes in physical fitness attributes after 5-month period of nutrition education intervention and FIFA11+ training in elite under 14 basketball players.

Variables	Before	After	p-value	Effect size, magnitude
Jump test				
CMJ (cm)	24.74 ± 5.62	27.70 ± 6.93	<0.001	0.89, strong
CMJ _{Right} (cm)	11.70 ± 3.03	13.62 ± 4.11	0.008	0.66, strong
CMJ _{Left} (cm)	12.66 ± 3.80	14.17 ± 4.29	0.040	0.52, strong
DJ (cm)	26.14 ± 6.39	26.97 ± 6.33	0.841	-0.06, trivial
Linear Sprint Test				
5 m sprint (s)	1.12 ± 0.08	1.19 ± 0.28	0.130	0.35, intermediate
10 m sprint (s)	2.00 ± 0.14	2.00 ± 0.14	0.908	0.03, small
20 m sprint (s)	3.46 ± 0.40	3.56 ± 0.26	0.159	0.37, intermediate
Change of Direction Ability (CODA) test				
Lane Agility Drill (s)	15.31 ± 1.00	14.29 ± 0.81	<0.001	-1.68, strong
505-COD (s)	2.68 ± 0.20	2.63 ± 0.17	0.166	-0.32, intermediate
Repeated change-of-direction (RCOD) sprint test				
RCOD sprint test time (s)	34.13 ± 2.06	33.23 ± 1.75	<0.001	-1.13, strong
RCOD-1	6.64 ± 0.40	6.58 ± 0.36	0.266	-0.26, small
RCOD-2	6.83 ± 0.42	6.63 ± 0.36	0.006	-0.67, strong
RCOD-3	6.88 ± 0.43	6.70 ± 0.38	0.001	-0.85, strong
RCOD-4	6.91 ± 0.46	6.67 ± 0.35	<0.001	-1.57, strong
RCOD-5	6.88 ± 0.42	6.66 ± 0.44	<0.001	-0.95, strong

Bolded p-value indicates statistical significance at $p < 0.05$.

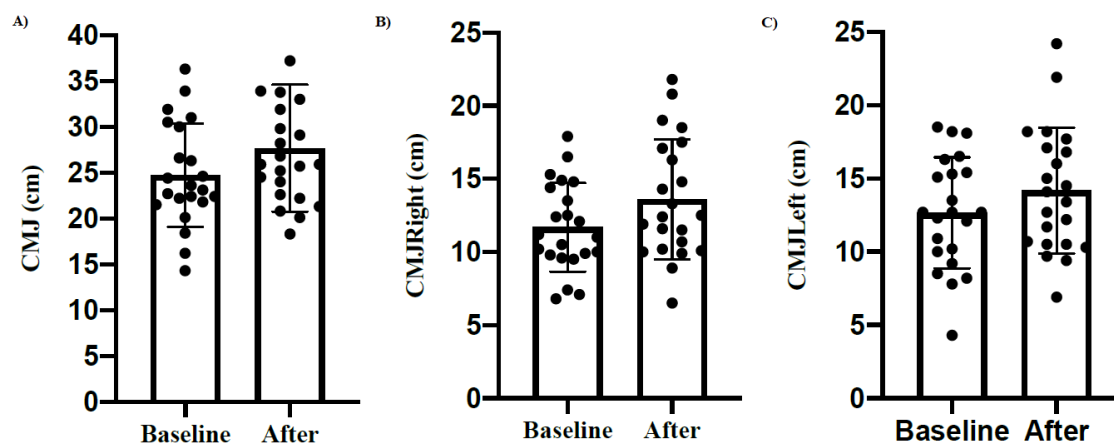


Figure 1. Individual changes after 5-months period in A) CMJ; B) CMJRight; C) CMJLeft.

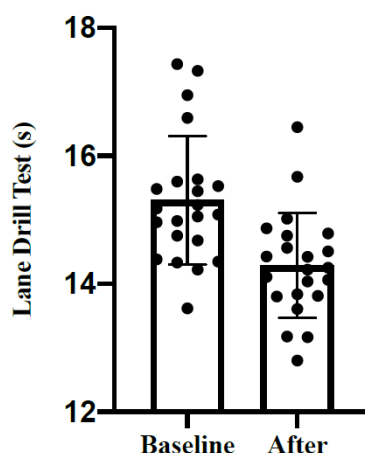


Figure 2. Individual changes after 5-months period in Lane Drill Test.

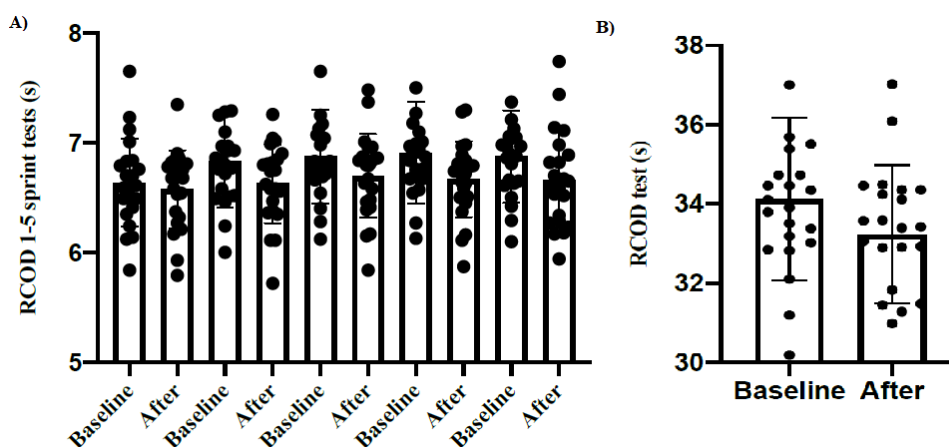


Figure 3. Individual changes after 5-months period in A) RCOD sprint 1-5 tests; B) RCOD sum time test.

Table 3. Changes in Physical Activity Questionnaire for Adolescents (PAQ-A) after 5-month period of nutrition education intervention and FIFA11+ training in elite under 14 basketball players.

	Baseline	After	p-value	Effect size, magnitude
PAQ1 _{mean} Activities	0.54 ± 0.35	0.63 ± 0.54	0.186	0.33, intermediate
PAQ2 Physical Education	81.53 ± 15.48	81.82 ± 23.38	1.000	0.03, trivial
PAQ3 Lunch	10.87 ± 19.69	27.27 ± 32.67	0.009	0.89, strong
PAQ4 4-6 pm	47.83 ± 33.64	53.41 ± 32.09	0.275	0.25, small
PAQ5 6-10 pm	48.91 ± 27.67	59.09 ± 25.05	0.189	0.30, small
PAQ6 Weekend	48.91 ± 26.63	48.86 ± 30.35	0.881	-0.03, trivial
PAQ7 Week intensity	30.44 ± 21.26	48.86 ± 27.25	0.055	0.46, intermediate
PAQ8 _{mean} Diary frequency	2.04 ± 0.42	2.36 ± 0.62	0.085	0.43, intermediate
PAQ _{total}	1.65 ± 0.48	1.97 ± 0.48	0.009	0.68, strong

PAQ1_{mean} Activities, Frequency of physical activities during leisure time across the last 7 days; PAQ2 Physical education, Frequency of being physically active during physical education sessions at school across the last 7 days; PAQ3 Lunch, Type of physical activity before and after lunch across the last 7 days; PAQ4 4-6 pm, Frequency of being physically active immediately after school during the last 7 days; PAQ5 6-10 pm, Frequency of being physically active between 6 and 10 pm across the last 7 days; PAQ6 Weekend, Frequency of being physically active during the last weekend; PAQ7 Week intensity, Weekly frequency of performing physical activity in leisure time; PAQ8_{mean} Diary frequency, Frequency of daily physical activity for each day of the week; PAQ_{total}, Total score obtained across the first eight questions in the questionnaire; Paired t-test was applied to total score and Wilcoxon rank sum test to questions 1 and 8, which contain data presented as mean ± standard deviation, while McNemar test were applied to all other questions which contain data presented as percentages. Bold value indicates significance at p < 0.05.

4. Discussion

Previous studies have shown the effectiveness of applying nutrition education programs and the FIFA 11+ program isolated in different populations of team sports athletes but scarce literature has focused in basketball players (Sánchez-Díaz et al., 2020) so it would be pertinent to analyze the influence of both strategies in a combined program. Therefore, the aim of this study was to analyze the effects of a nutritional education program combined with the FIFA 11+ program on physical fitness attributes, physical activity behaviors, eating habits and nutrition knowledge in elite U14 basketball players. The main results obtained have shown that the usual on-court training and the implementation of nutrition education interventions combined to the FIFA 11+ program consistently induced positive changes in physical fitness attributes (i.e., CMJ, Lane Drill Test and RCOD time test) and improved physical activity behaviors (PAQ_{total} and PAQ Lunch). Otherwise, a maintenance of eating and nutritional habits and nutrition knowledge was observed in elite U14 basketball players.

One of the main goals of strength and conditioning specialists of team sports athletes (e.g., basketball) is to ensure that players meet the physical requirements of competition (Castillo et al., 2021b) and to mitigate the fatigue-related injury risk in order to optimize the physical performance and increase players' availability (Mujika et al., 2018). So that, the inclusion prevention training routines as well as the improvement of nutritional intake behaviors could optimize the preparedness of basketball players for competition (Sánchez-Díaz et al., 2021). Our results indicated that elite U14 basketball players enhanced their physical fitness attributes in terms of bilateral and unilateral CMJ height, time spent in Lane Agility Drill test, and RCOD sprint test times after the 5-months in which the nutrition education interventions and FIFA11+ program were applied. This is the first investigation analyzing the effect of

combined nutrition education interventions and physical conditioning program on physical fitness, although previous studies including these nutritional and training strategies in an isolated way showed controversial results attending to team sports athletes. In this sense, Kavouras et al. (2012) and Shoemaker et al. (2019) observed improvements in physical fitness in team sport players (i.e., endurance and jump abilities) after the application of several nutrition education interventions. Conversely, in the study conducted by Rossi et al. (2017) no significant differences were observed comparing the intervention group (i.e., nutrition education intervention) with their counterparts belonging to the control group. In addition, Nawed et al. (2018) observed enhances in several attributes of physical performance in soccer players after the application of the FIFA11+ program. Attending to the aforementioned results, these findings suggest that the physical fitness attributes in young basketball players could be improved by the inclusion of a combined program based on nutrition education interventions and the FIFA11+ training to the usual on-court training. Nevertheless, future studies could investigate the effectiveness of these strategies adding a control group although it would be difficult to find high-level young basketball teams and the sample for each group would be low.

In addition to the effects on physical fitness, it is also of great interest to know the influence of the purposed intervention on the level of practice outside the sports context due to its positive effects on athletic performance (Mujika et al., 2018). As such, the results of our study showed that elite U14 basketball players ameliorated the sum of scores in PAQ_{total} questionnaire and the type of physical activity before and after lunch across the last seven days after 5-months period of nutrition education intervention and FIFA 11+ training. Since this is the first investigation carried out in young basketball players considering this specific variable (i.e., PAQ), our results are

not comparable with those obtained in previous studies. However, we hypothesize that the improvements obtained could be due to the fact that with the knowledge contributed during nutrition education interventions they influence healthy lifestyle habits in a multifactorial way, including physical activity outside. In addition, the fact of including specific conditioning programs in training routines (i.e., the FIFA 11+ program) can favor the creation of sports habits in young athletes. Therefore, the inclusion of nutrition and prevention training interventions in daily routine of elite basketball academies could be justify due to the positive influence found on equating the practice of physical activity in wider social contexts.

Conversely, our results did not report significant changes in food habits (section B) nutritional habits (section C) and nutrition knowledge (section H) using the modified version of Turconi questionnaire (Sánchez-Díaz *et al.*, 2021) after 5-months period of nutrition education intervention combined with the FIFA 11+ training program in elite U14 basketball players. A priori, these results could be surprising, however, previous studies have already reported the existing controversy, mainly attributed to the intervention's modality, frequency and duration (Sánchez-Díaz *et al.*, 2020). Although some studies have showed modifications in carbohydrate, protein, fat and/or total energy intakes after nutrition education interventions in team sports athletes (Elias *et al.*, 2018; Molina-López *et al.*, 2013; Valliant *et al.*, 2012; Wenzel *et al.*, 2012), other studies reported no significant changes in nutritional intakes (Anderson, 2010; Patton-Lopez *et al.*, 2018; Zeng *et al.*, 2020) in experimental groups. Additionally, the participants of our study are minors and, normally, they depend on their parents/guardians. That is, the players do not buy the food, nor do they cook it, and probably some of them eat at high school. Consequently, it can be said that they do not have the ability to change if their parents / guardians do not change. Perhaps, this fact

may have influenced the results obtained and it could be interesting to design workshops aimed at parents / guardians on appropriate nutritional behaviors in young people. Attending to nutritional knowledge, no improvements in scores of section C of Turconi questionnaire could be explained by modality of interventions (i.e., online) as occurred in the study of Reading *et al.* (1999) in which no changes in nutrition knowledge were detected following the intervention applied in youth ice-hockey players using the modified version of SNAC questionnaire, or indeed by age of participants. Despite the reported results, it is suggested to include nutrition education interventions in daily routines because could provide relevant knowledge for team sport athletes, regarding the nutritional properties of food and nutritional knowledge, which could lead to consumption of varied and balanced diets that provide essential nutrients to enhance performance and recovery. However, it could more appropriate to include higher frequency and time-period as well as face-to-face modalities.

This study is not exempt of limitation being the main one the sample size recruited in the study, since only elite U14 basketball players were part of the sample. Accordingly, future studies should expand on this work examining larger samples of players from other age categories and competitive-levels of play (i.e., international). In addition, it would be interesting to analyze potential sex differences in the effects of combined nutrition education interventions and FIFA 11+ training. Also, although many studies imply only one experimental group (single-arm design), it would be interesting to know the effects on physical fitness attributes, physical activity behaviors, eating and nutritional habits and nutrition knowledge following a double-arm design. In addition, since the physical fitness has been assessed by the specific tests, it would be adequate to analyze the in-game performance during basketball competition. Consequently,

future studies are encouraged examining the effects of combined nutrition education interventions and prevention strategies on in-game performance variables to provide evidence with greater ecological validity on this topic.

5. Practical Applications.

In practical terms, the inclusion of nutrition education interventions combined with the FIFA 11+ program must be implemented in basketball academies environment not only to improve the players performance, but also to improve their quality of life in terms of physical activity behaviors.

6. Conclusions

The results of this study have shown positive changes in physical fitness attributes (i.e., CMJ, Lane Drill Test and RCOD time test) and improved physical activity behaviors (PAQtotal and PAQ Lunch), as well as a maintenance of eating and nutritional habits and nutrition knowledge in elite U14 basketball players after a 5-months period based on the combined implementation of nutrition education interventions with the FIFA 11+ training program. However, no gender differences in response to the intervention were found.

Supplementary Materials: The following are available online at <http://eurjhm.com/index.php/eurjhm>, Table S1: Changes in food habits after 5-month period of nutrition education intervention and FIFA11+ training in elite under 14 basketball players, Table S2: Changes in nutritional habits attributes after 5-month period of nutrition education intervention and FIFA11+ training in elite under 14 basketball players, Table S3: Changes in nutritional knowledge after 5-month period of nutrition education intervention and FIFA11+ training in elite under 14 basketball players.

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